



PATENT
1817-0141P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: Sean TIMONEY Conf.:
Appl. No.: 10/628,413 Group:
Filed: July 29, 2003 Examiner:
For: A SUSPENSION UNIT

L E T T E R

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

October 1, 2003

Sir:

Under the provisions of 35 U.S.C. § 119 and 37 C.F.R. § 1.55(a), the applicant(s) hereby claim(s) the right of priority based on the following application(s):

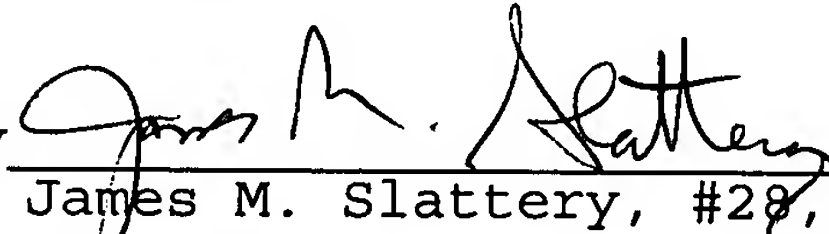
<u>Country</u>	<u>Application No.</u>	<u>Filed</u>
IRELAND	S2002-0628	July 29, 2002

A certified copy of the above-noted application(s) is(are) attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By 
James M. Slattery, #28,380

JMS/ndb
1817-0141P

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Attachment(s)



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Patents Office
Government Buildings
Hebron Road
Kilkenny

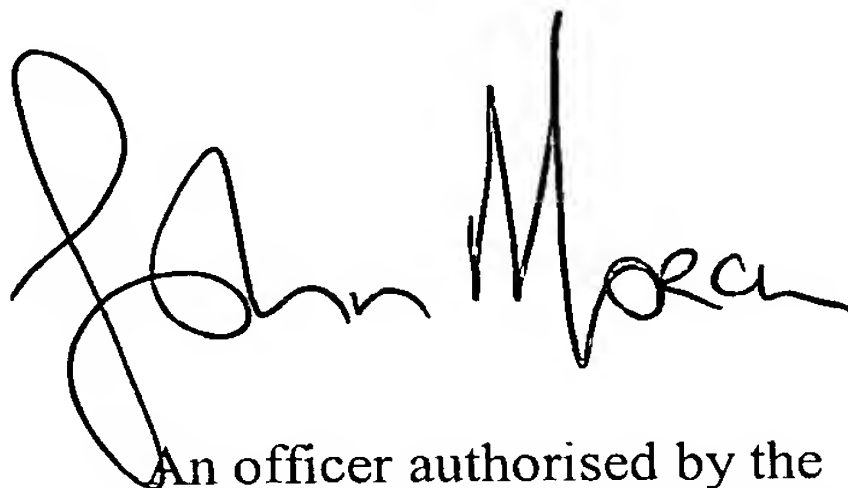
I HEREBY CERTIFY that annexed hereto is a true copy of the documents filed in connection with the following patent application:

Application No. S2002/0628

Date of Filing 29th July, 2002

Applicant TECHNOLOGY INVESTMENTS LIMITED, an
Irish company of Gibbstown, Navan, County
Meath, Ireland

Dated this 1st day of August 2003.



An officer authorised by the
Controller of Patents, Designs and Trademarks.

FORM NO. 1

REQUEST FOR THE GRANT OF A PATENT

PATENTS ACT 1992

The Applicant(s) named herein hereby request(s)
 [] the grant of a patent under Part II of the Act
 [X] the grant of a short-term patent under Part III of the Act
 on the basis of the information furnished hereunder.

1. Applicant(s)

TECHNOLOGY INVESTMENTS LIMITED.
 Gibbstown
 Navan
 County Meath
 Ireland
 an Irish Company

2. Title of Invention

A suspension unit

3. Declaration of Priority on basis of previously filed application(s) for same invention (Sections 25 & 26)

<u>Previous Filing</u> <u>Date</u>	<u>Country in or for</u> <u>which filed</u>	<u>Filing No.</u>
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4. Identification of Inventor(s)

Name(s) and addresse(s) of person(s) believed
by the Applicant(s) to be the inventor(s)
 Sean Timoney
 an Irish Citizen of 5 St Marys Road, Dublin 4, Ireland

5. Statement of right to be granted a patent (Section 17(2) (b))

The Applicant derives the right to apply by virtue of a Deed of Assignment dated July 25, 2002

6. Items accompanying this Request

- (i) [X] prescribed filing fee (Euro 60.00)
- (ii) [] specification containing a description and claims
[X] specification containing a description only
[X] Drawings referred to in description or claims
- (iii) [] An abstract
- (iv) [] Copy of previous application(s) whose priority is claimed
- (v) [] Translation of previous application whose priority is claimed
- (vi) [X] Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

7. Divisional Application(s)

The following information is applicable to the present application which is made under Section 24 -

Earlier Application No.
Filing Date:

8. Agent

The following is authorised to act as agent in all proceedings connected with the obtaining of a patent to which this request relates and in relation to any patent granted -

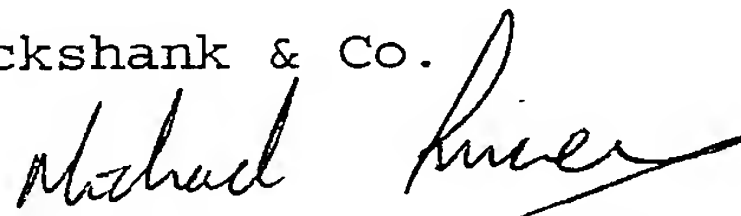
Name & Address

Cruickshank & Co. at their address recorded for the time being in the Register of Patent Agents is hereby appointed Agents and address for service, presently 1 Holles Street, Dublin 2.

9. Address for service (if different from that at 8)

Signed Cruickshank & Co.

By:-



Executive.

Agents for the Applicant

Date July 29, 2002.



This invention relates to vehicle suspension units, and in particular to hydrogas suspension units.

5

Vehicle suspension units using a gas such as nitrogen as the spring medium together with an hydraulic fluid to transmit wheel loads and provide the damping medium are sometimes referred to as "hydrogas" suspension units. They have the advantage of a progressive spring characteristic determined by the gas law. Furthermore, this characteristic can be readily adjusted by altering the volume of oil and/or gas in the unit. The amount of damping can also be changed, by changing the damping orifice and blow-off springs.

15

In certain circumstances it is desirable to have a symmetrical spring characteristic such that the spring has similar characteristics in bounce and rebound. Such a situation arises in the rather unusual case where the suspension is required to function when the vehicle is inverted. Also, it may be required that the static height of the vehicle should be readily adjustable. The present invention is aimed at achieving these requirements.

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According to the invention there is provided a suspension unit which includes two hydrogas units acting in opposition to each other.

25

In one embodiment there is provided a hydrogas suspension unit for acting on a leading or trailing suspension arm connected to a vehicle wheel and the suspension unit, the suspension unit including a pair of hydrogas units arranged to urge the suspension arm in opposite directions.

30

In a further embodiment each suspension unit is operatively connected to a crankshaft, the suspension units urging the crankshaft in opposite directions, the crankshaft for connection to the suspension arm.

In another embodiment each hydrogas unit includes an oil cylinder and an associated gas cylinder with a separator piston between the oil cylinder and the gas cylinder, the

oil cylinder having two associated oil chambers interconnected through a damper unit which regulates oil flow between the oil chambers, a plunger piston in the oil cylinder which is connected to the crankshaft by a connecting rod.

- 5 In another aspect the invention provides a suspension system incorporating the suspension unit or assembly of the invention as herein described.

The invention will be more clearly understood by the following description of some embodiments thereof, given by way of example only, with reference to the
10 accompanying drawings, in which;

Fig. 1 is a sectional elevational view of a dual hydrogas suspension unit of the invention;

15 Fig. 2 is a perspective view of the unit, shown in use,

Fig. 3 is a partially sectioned elevational view of another dual hydrogas suspension unit according to a second embodiment of the invention;

20 Fig. 4 is a graph illustrating wheel deflection characteristics typical of the suspension unit of the invention; and

Fig. 5 shows an enlarged diagram of the "upright quadrant" of the wheel deflection characteristic for the unit.

25

Referring to the drawings there is illustrated a dual hydrogas suspension unit or assembly according to the invention indicated generally by the reference numeral 1. It will be noted that the suspension assembly 1 provides an associated pair of hydrogas units acting in opposition to one another. The suspension assembly 1 acts
30 on a leading or trailing suspension arm 3 which is connected to a wheel 4 of a vehicle in use.

The suspension assembly 1 has an upper hydrogas unit 10 and a lower hydrogas unit 20 which act in opposition to each other. Each hydrogas unit 10, 20 has an oil

cylinder 11, 21, a gas cylinder 12, 22, a damper unit 13, 23, a separator piston 14, 24, a plunger piston 15, 25 and a connecting rod 16, 26 respectively. The separator piston 14, 24 divides the gas cylinder 12, 22 into a gas volume 17, 27 and an oil volume 18, 28. The gas volume 17, 27 is charged with nitrogen or another suitable gas that acts as the spring medium. Each oil volume 18, 28 in the gas cylinder 12, 22 is separated from a further oil volume 19, 29 in the associated oil cylinder 11, 21 by the damper assembly 13, 23 which allows oil to flow between the associated oil volumes 18, 28 and 19, 29 with a pressure drop related to the oil flow rate.

10 The pressures in each of the oil volumes 19, 29 acting on the plunger pistons 15, 25 exert opposing forces through the connecting rods 16, 26 on a crankshaft 2. The resultant torque on the crankshaft 2 resists suspension forces applied to a leading or trailing suspension arm shown as reference numeral 3 in Fig. 2 which is operatively connected to the crankshaft 2. A communicating passage between oil volumes 19 and 29 or 18 and 28 allows oil to be pumped from the lower hydrogas unit 20 to the upper hydrogas unit 10 or vice versa.

Fig. 3 shows another arrangement of dual hydrogas suspension unit, indicated generally by the reference numeral 40. Parts similar to those described previously are assigned the same reference numerals. In this case the two hydrogas units 10, 20 are arranged in a juxtaposed horizontal configuration with one above the other as an alternative to the opposed upright configuration of the embodiment of Fig. 1. It will be noted however that as previously described the forces applied through the connecting rods 16, 26 to the crankshaft 2 act in opposite directions. It will be appreciated that the pair of hydrogas units 10, 20 could alternatively be supported in an upright orientation or at an inclined angle to the horizontal.

Wheel deflection characteristics typical of a suspension system according to the invention are shown in Fig. 4. Characteristic 1 is for a symmetrical system in which the upper hydrogas unit 10 and lower hydrogas unit 20 are identical and are charged with identical quantities of oil and gas. Characteristics 2 to 6 are obtained by pumping incremental quantities of oil from the lower to the upper cylinder. Characteristics 2' to 6' are obtained by pumping incremental quantities of oil from the upper to the lower cylinder. It will be noted that the direction of pumping may be

inverted if the orientation of either the crankshaft 2 or trailing arm 3 are changed in a particular embodiment of the invention.

5 For an invertable vehicle, the "upright quadrant" of the diagram would generally be used when the vehicle is in the upright position while the "inverted quadrant" would be used when the vehicle is inverted.

10 Fig. 5 shows an enlarged diagram of the "upright quadrant" of the wheel deflection characteristic. The dynamic characteristic differs from the static characteristic, as it is no longer isothermal.

15 It will be appreciated that the invention may be applied in many variations. A non-symmetric system may be used in which the upper hydrogas unit 10 and the lower hydrogas unit 20 are not identical. The invention may also be used in vehicles which are not required to invert, to enable load compensation or to allow the vehicle to squat.

20 It will also be noted that various configurations of the hydrogas unit pistons are possible such as the directly opposite orientation of Fig. 1 and the juxtaposed orientation of Fig. 3. Other possibilities include a V-formation. The hydrogas unit pistons can be arranged in any desirable configuration for a particular application so long as the torques applied to the crankshaft act in opposite directions.

25 The invention is not limited to the embodiments hereinbefore described and may be varied in both construction and detail.

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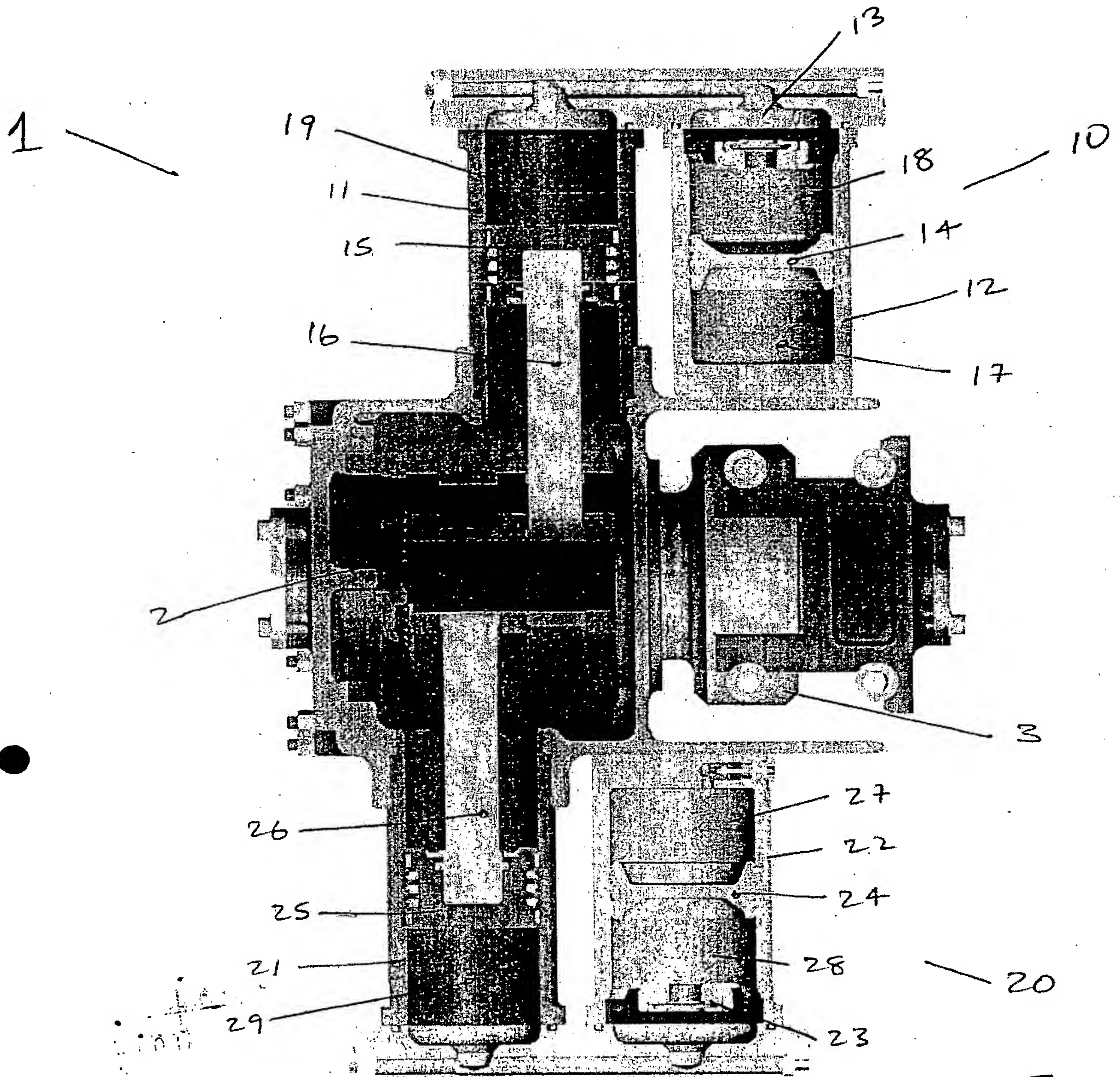
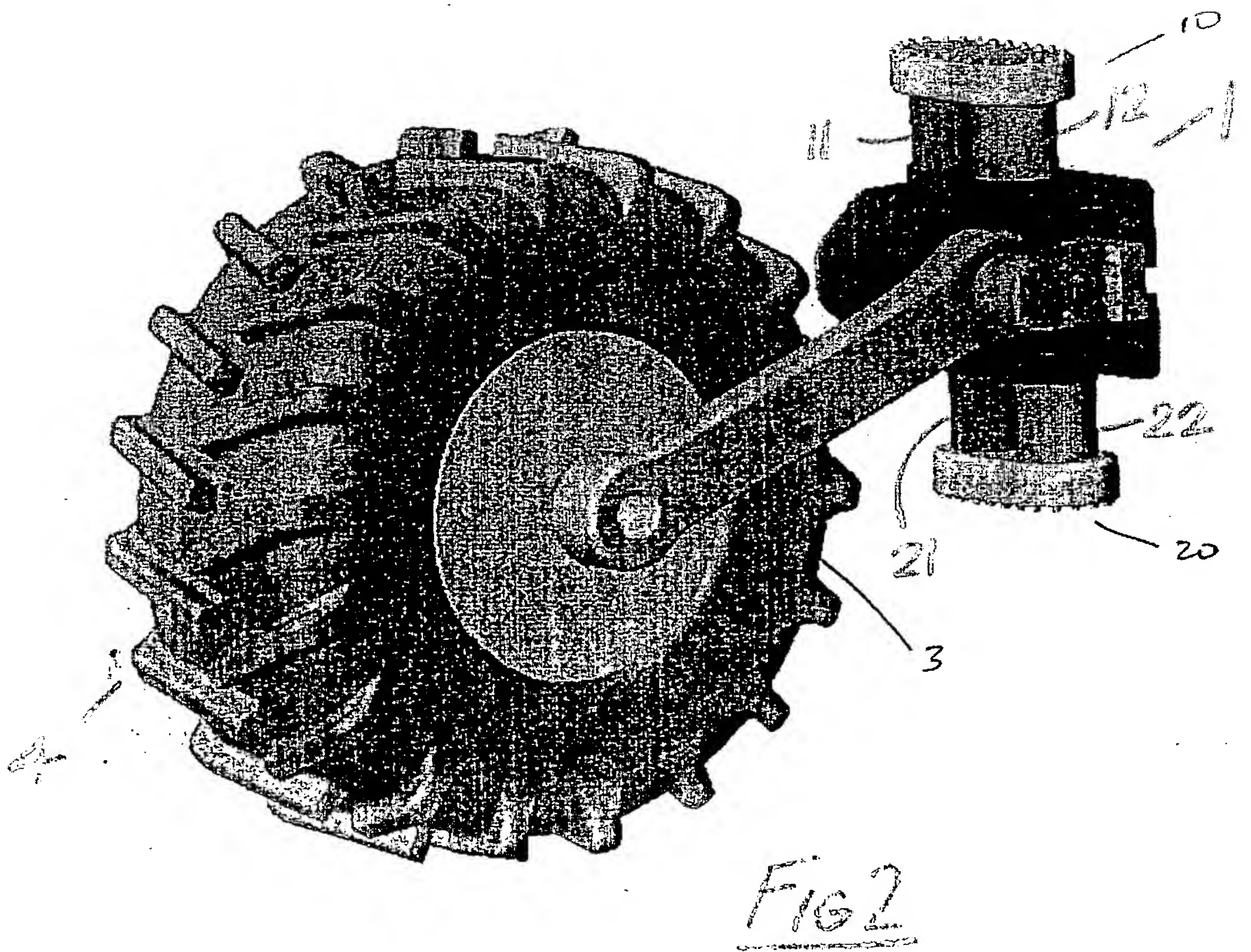
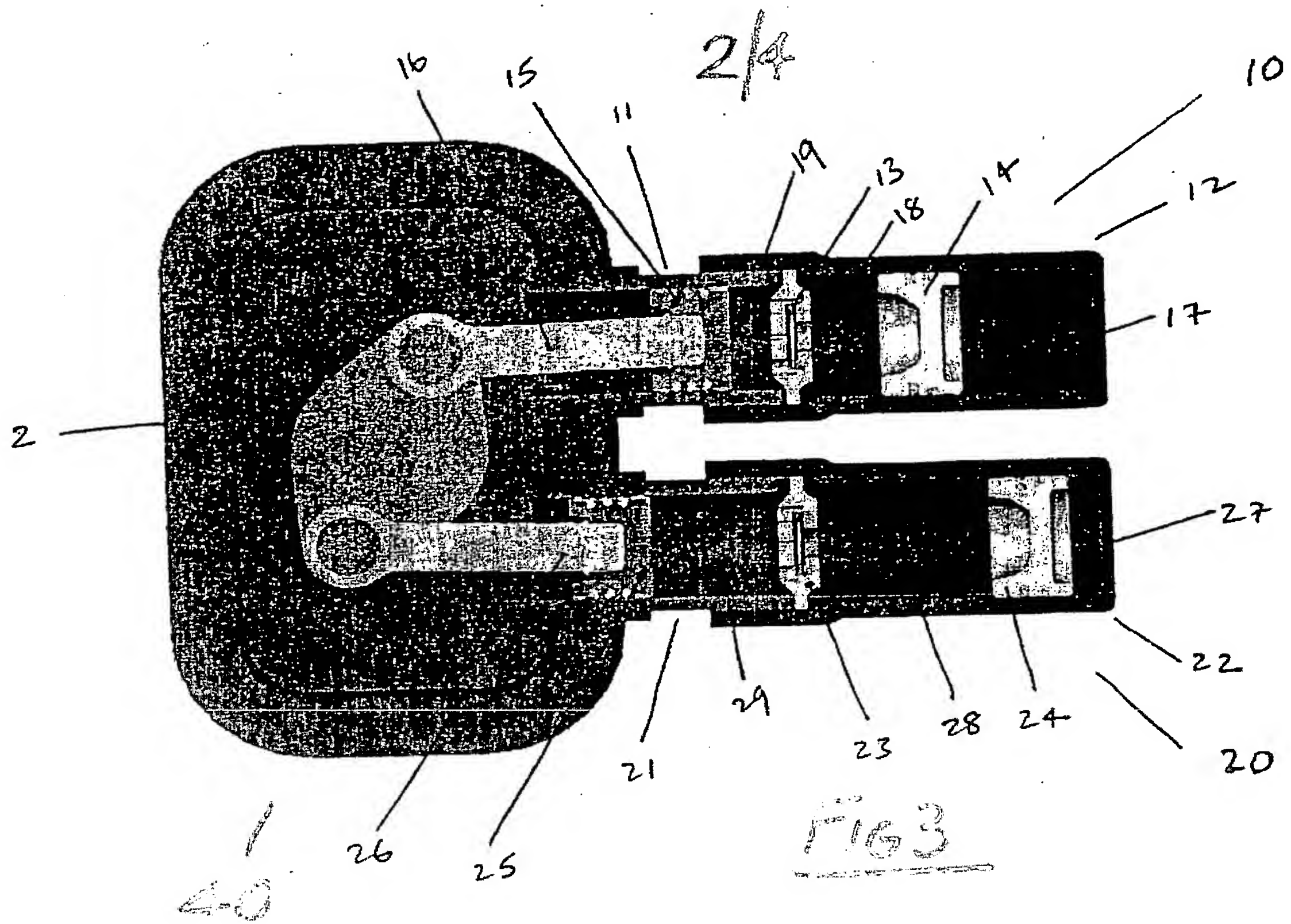


FIG 1



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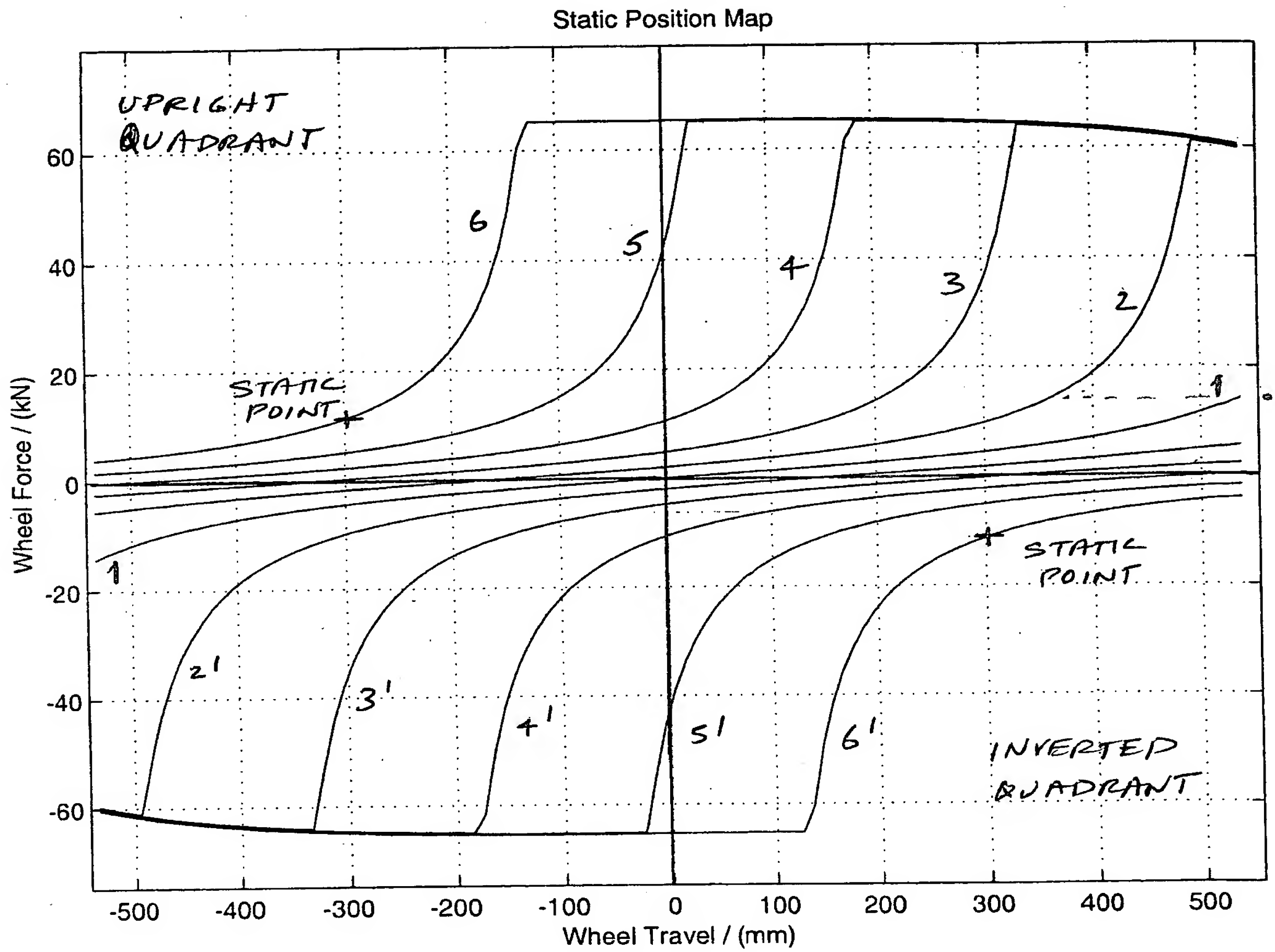


FIG 4

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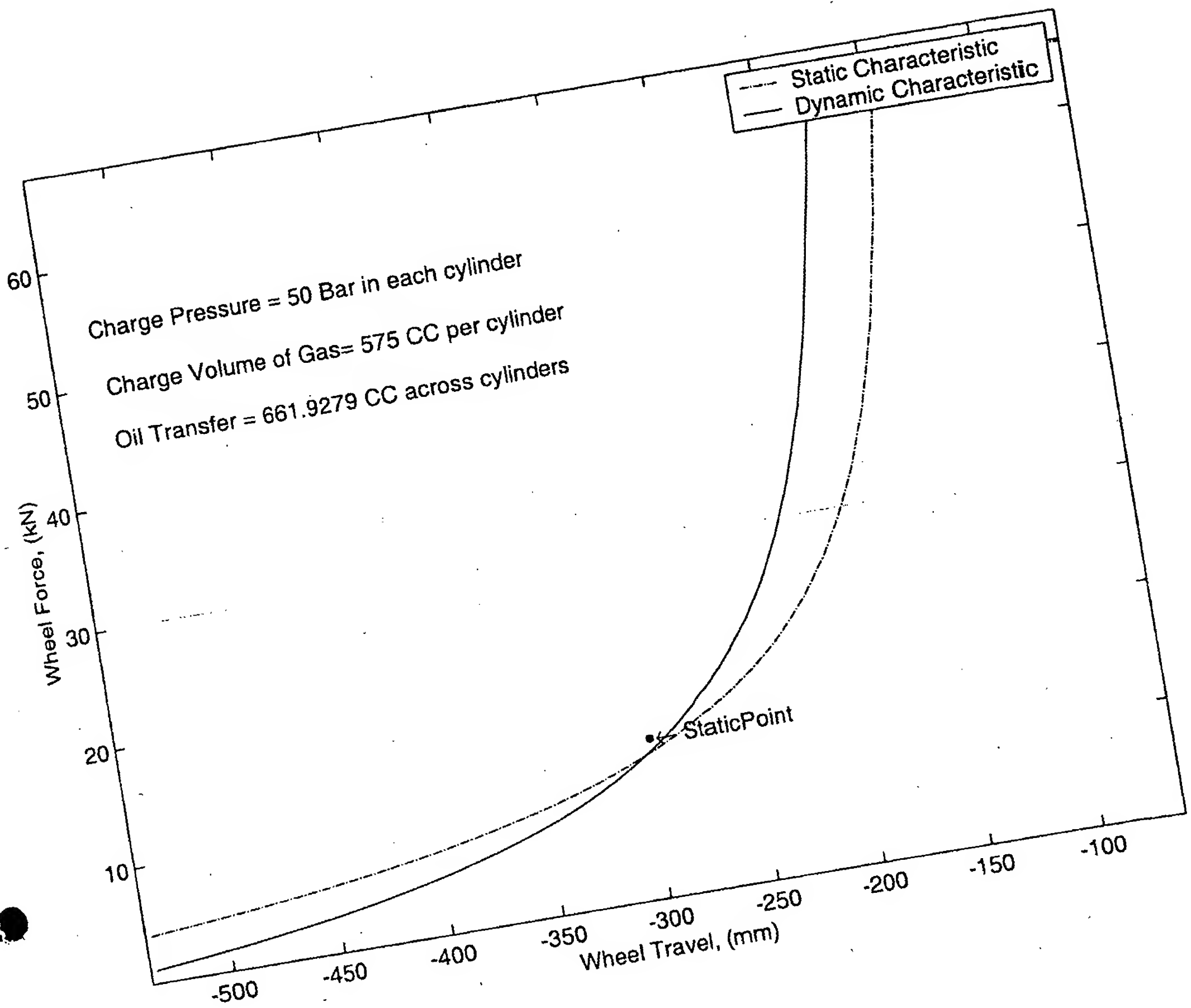


FIG 5